STEREOSCOPIC DISPLAY DEVICE WITH TWO BACK LIGHT SOURCES

BACKGROUND OF THE INVENTION

The invention relates to a stereoscopic display device comprising a transmissive image reproducing element with two light sources on the rear side of this element.

DESCRIPTION OF PRIOR ART

For reproducing stereoscopic TV images, it is known to provide, on a display, alternately, an image for the left eye and an image for the right eye and to provide optical means directing the left image to the left eye and the right image to the right eye.

It has been more particularly proposed a LCD type display device wherein the picture elements (pixels) of the transmissive LCD are alternately activated in order to reproduce the image for the left eye and the image for the right eye. In this known device, two light sources and a lens are provided on the rear side of the (LCD) image reproducing element. These sources are located in the focal plane of the lens. The position of one source is such that the parallel beam that it produces on the front side of the LCD is directed towards the right eye and the other source is located in a position for which the parallel beam that it produces is directed towards the left eye. These sources are activated in synchronism with the corresponding images. In other words, the source which provides light directed towards the right eye is lit when the right image is activated on the LCD.

SUMMARY OF THE INVENTION

The invention is based on the recognition that the volume of the known device is hardly compatible with portable applications such as for lap top computers or individual movie displays.

In order to overcome this drawback, the invention provides mirror means to direct the light emitted by one light source towards the right eye and to direct the light emitted by the other source towards the left eye, the light sources and the image reproducing element being installed on the same side of the mirror means.

As, in the known device, the light sources and the image reproducing element are on opposite sides of a lens, the volume of the device according to the invention may be smaller than the volume of the known device.

The mirror means may provide parallel beams or converging beams.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will appear with the following description of some of its embodiments, this description being made in connection with the drawings in which:

figure 1 represents schematically a stereoscopic display according to an embodiment of the invention,

figure 2 represents a Fresnel mirror for the device of figure 1,

figure 3 is another representation of the device of figure 1,

figure 4 shows another type of Fresnel mirror for the device of figure 1 or figure 3, and

figure 5 shows an embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

In the embodiments represented on the drawings, the stereoscopic display device comprises a liquid crystal display 10 comprising a multiplicity of pixels for which the transmissivity and the color is controlled in order to form the image. In order to display stereoscopic moving images, the period of one image (one frame) is divided into two fields wherein the first (or second) field produces the image for the right eye and the second (or first) field produces the image for the left eye.

Two light sources 40 and 46 (figure 1 and figure 3) are lit alternately in synchronism with the reproduction of the images for the right eye and the images for the left eye. The light source 40 is energized when the image for the right eye 44 is reproduced on LCD 10 and the light source 46 is energized when the LCD 10 reproduces the image for the left eye 48. In the embodiment shown, the mirror 42 (figure 1) or 42_1 (figure 4) is converging and of the Fresnel type. This mirror makes an image of the right source 40 on the right eye 44 and an image of the left source 46 on the left eye 48.

During the first field, only the light source 40 is active and LCD 10 displays only the image for the right eye.

During the second field, only light source 46 is active and LCD 10 displays only the left image.

As shown on figure 1, the light source 40 is active when the LCD 10 displays the right image and the converging mirror 42 makes the image of this source 40 on the right eye 44. Similarly, the light source 46 is active only when LCD 10 displays the left image and the mirror 42 makes the image of this source 46 on the left eye 48.

The position of LCD 10 with respect to sources 40, 46 and with respect to the mirror 42 must be such that the light from sources 40 and 46 must cross this LCD 10 only after having been reflected by mirror 42.

The advantage of this embodiment is that it may be compact, because the light sources 40 and 46 are on the same side of mirror 42 as LCD 10. On the contrary, in the known device, the light sources, on one hand, and the LCD 10, on the other hand, are on opposite sides of a lens.

In the embodiments represented on the figures, the light sources 40 and 46 (figure 3) are elongated along one side of element 10 of rectangular shape.

The Fresnel mirror 42 represented on figure 2 has alternate elongated stripes 50_1, 52_1, 50_2, 52_2, etc. The direction of elongation is the direction of elongated light sources 40 and 46. The elongated stripes 50_1, 50_2, 50_3 ... 50_i ... form a first converging mirror and the second elongated stripes 52_1, 52_2 ... 52_i ... form a second converging mirror. The first converging mirror is the one which makes the image of source 40 on the right eye 44 (figure 1) and the second mirror, with elongated elements 52_i, makes the image of light source 46 on the left eye 48.

In this example, the two Fresnel mirrors (stripes 50_i and 52_i) are of the cylindrical type.

In order to distribute the light energy of each source 40 and 46 on LCD 10, it is possible to use a diffuser and/or an optical integrator (not shown).

In the embodiment shown on figure 4, the Fresnel mirror 42_1 has also two types of alternated elongated stripes 54_1, 56_1, 54_2, 56_2, etc. which form converging mirrors for the right and the left eyes. But the shapes of these mirrors are such that they can be used in conjunction with light sources of the punctual type. For instance, the two mirrors define an ellipsoïdo-paraboloïd of revolution.

The light sources may be of any type, for instance light emitting diodes (LED). One or several diodes may be used to form a punctual light source and these light diodes may be also disposed along a line in order to form elongated light sources.

The transmissive image reproducing element 10 may be of any type, either black and white or colored.

In another embodiment, the light sources 40 and 46 are at focal point(s) or plane(s) of a mirror and provide parallel beams respectively to right eye 44 and to left eye 48.

In the embodiment represented on figure 5, only one light source 60 is provided and the mirror means 62 comprises an array of mirror elements 64_1, 64_2, etc. the orientation of which is controlled by motor means and a control circuit, both being represented by a block 66. The goal of the block 66 is to focus the light beam generated by a source 60 and reflected by each mirror element, alternately on the right eye 68 and on the left eye 70.

Like in the embodiment represented on figure 1, the LCD 10 is controlled in order to display alternately the images for the right eye and for the left eye. This control of the display 10 is realized with a synchronization signal provided at an input 72_1 of a control circuit 72 for the LCD 10. Said control circuit 72 has also an input 72_2 receiving the signals for the left and the right images.

The same synchronization signal which is provided to the input 72_1 of control circuit 72 for the LCD 10 is also provided to an input 66_1 of the block 66 for controlling the tilt of mirror elements 64_1, 64_2, etc.

Compared to the embodiment of figure 1, only one light source 60 is provided instead of two. Therefore, the device is less bulky; this feature is particularly advantageous for a portable device.

The mirror elements 64_1, 64_2, etc. may be either elongated elements (stripes), preferably in one direction, as those represented with figure 2 and figure 4, or small elements disposed in a matrix -like manner. In the latter case, a plurality of elements are provided on each column and on each line.

The control of the orientation or tilt of the mirrors may be realized conventionally like in a digital mirror device (DMD).

The light source 60 may have the shape of a point or an elongated shape, like lamp 40 represented on figure 3.

It may be necessary to use optical means (not shown) for a correct focusing at points 68 and 70, these optical means being installed between the light source 60 and the mirror means 62 and/or between the mirror means 62 and the focus points 68 and 70.